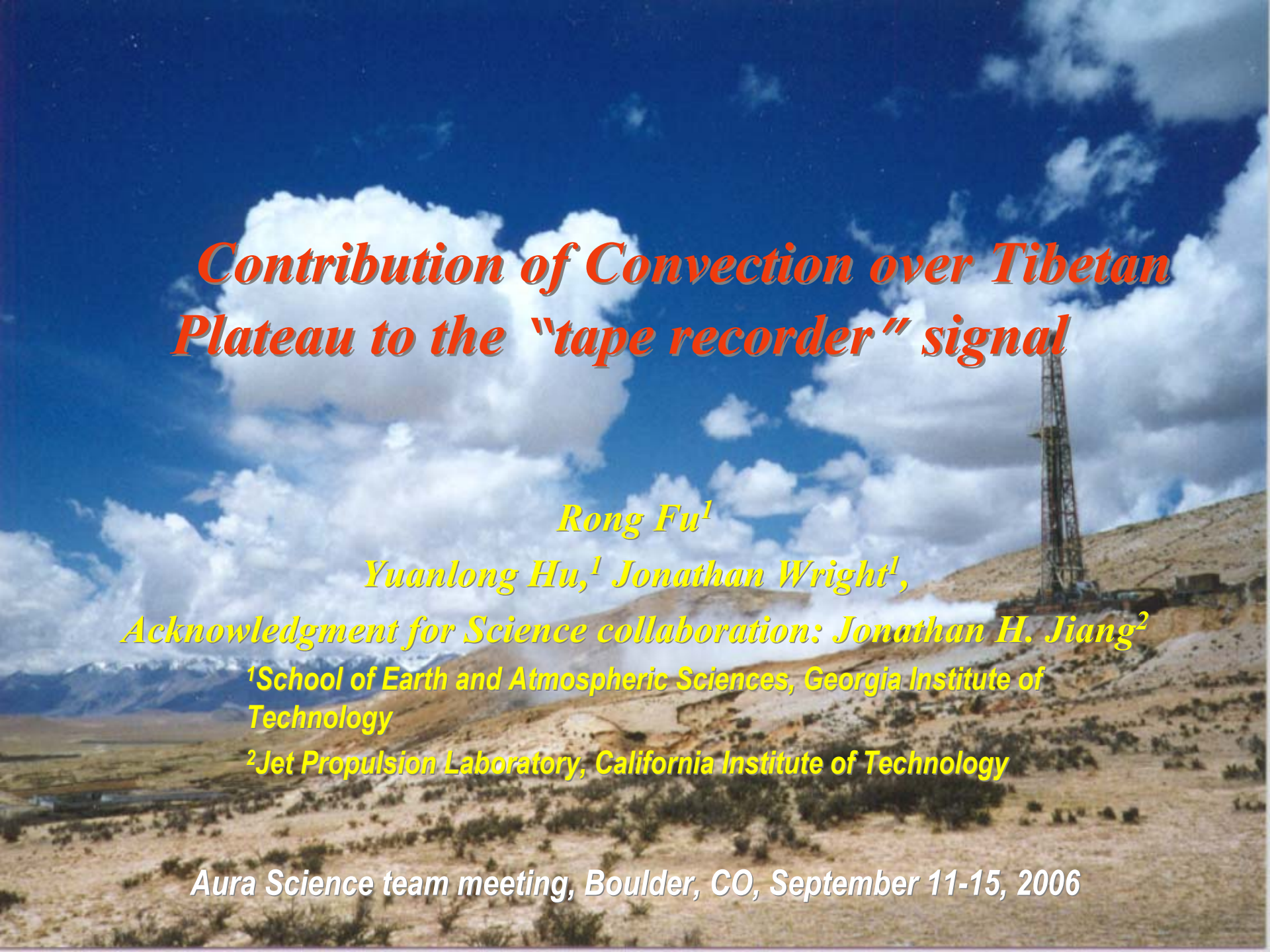

Contribution of Convection over Tibetan Plateau to the "tape recorder" signal

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Acknowledgment for Science collaboration: Jonathan H. Jiang[2]

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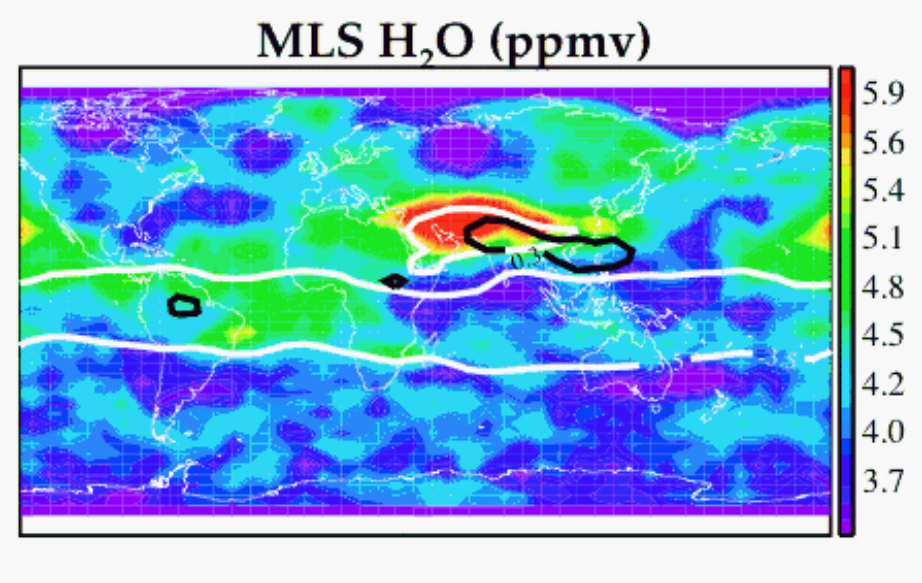
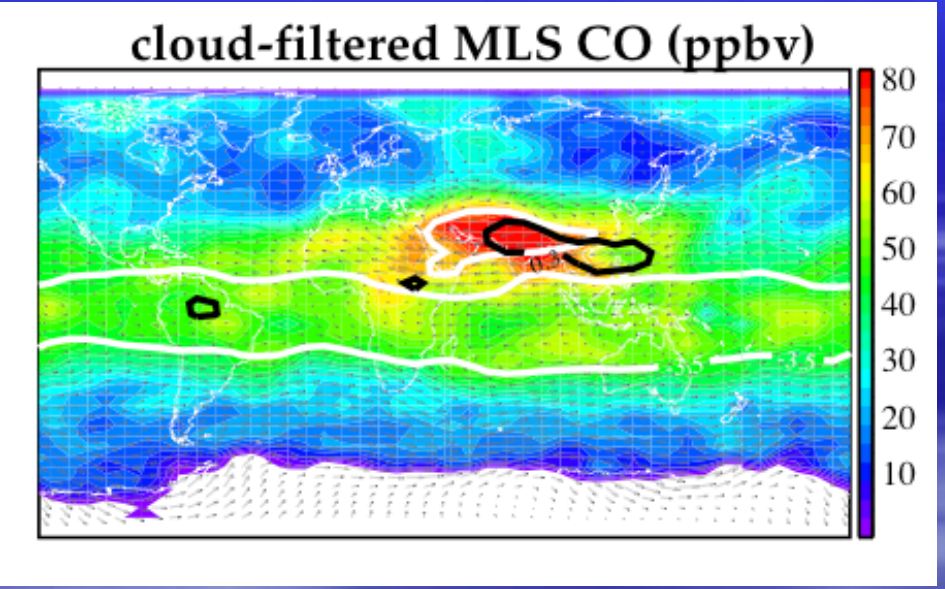
Aura Science team meeting, Boulder, CO, September 11-15, 2006

Asian Monsoon/Tibetan region is a main gateway for near surface air to enter LS during boreal summer.





Aura MLS, July 23-29, 2006,

Chen 1995; Dunkerton 1995; Rosenlof et al. 1997:

Jackson et al. 1998, Randel et al. 2001; Read et al. 2004

Gettelman et al. 2004

- ***How is water vapor transported to the LS over the Asian monsoon region/Tibetan region?***
  - ***By monsoon convection or convection over Tibet?***

    Dethop et al. 1999: monsoon convection

    Dessler and Sherwood 2004: extratropical convection

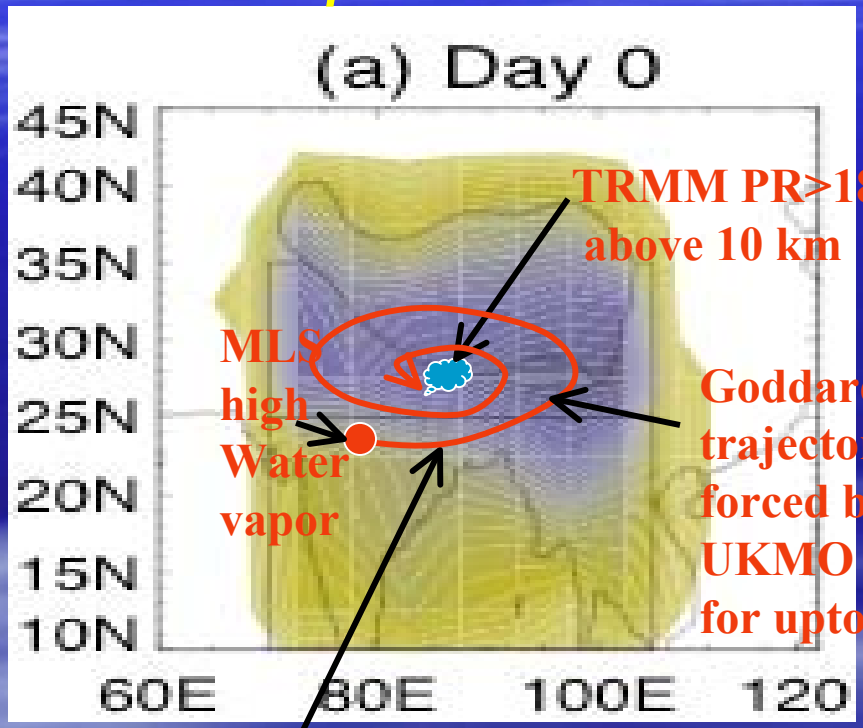
    Gettelman et al. 2004, Fueglistaler et al. 2005: both

    Fu et al. 2006: Convection over Tibetan Plateau

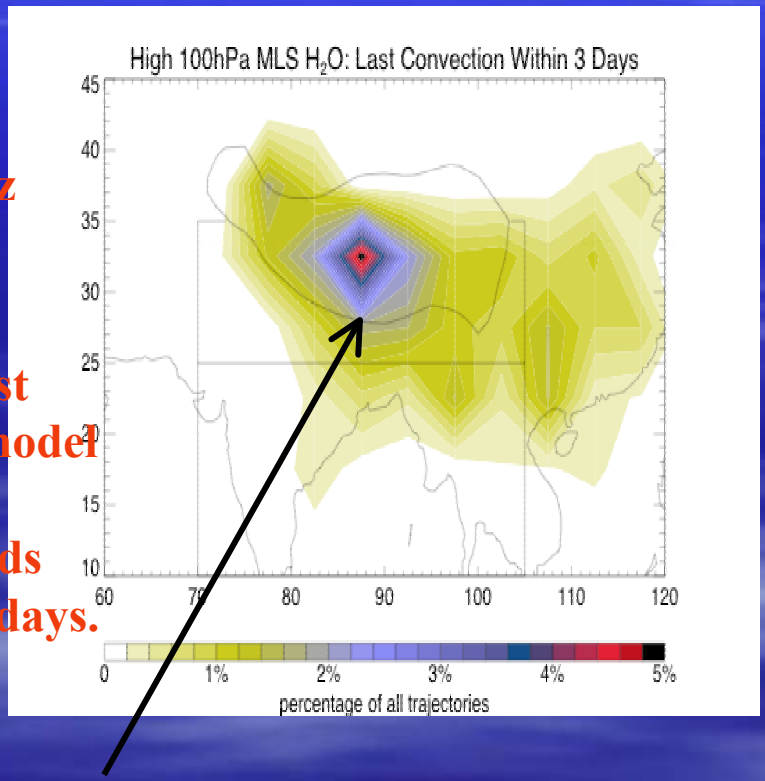
- ***Can LS water vapor in the Asian monsoon/Tibetan region enters the "tropical pipe" and influenced the global stratosphere?***

Most of high water vapor air over the Asian monsoon region is originated from the Tibetan Plateau

Water vapor at 100 hPa:

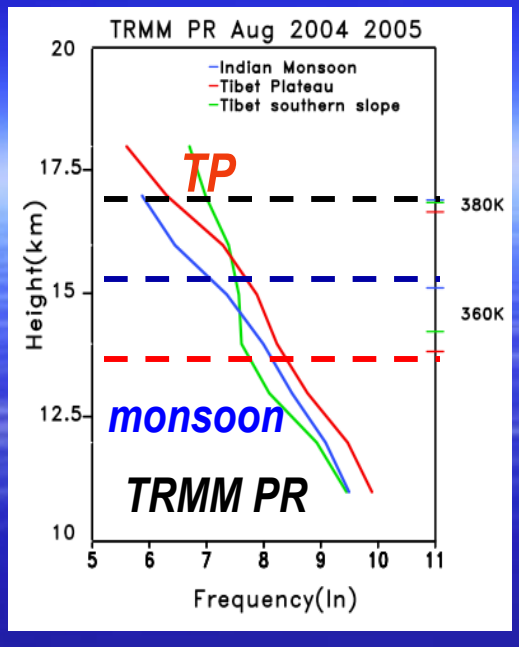


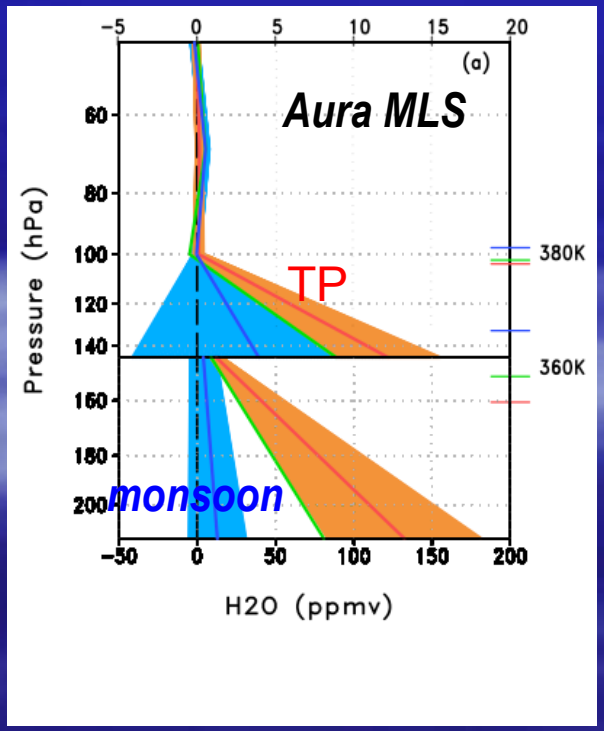
Probability of Convective Source



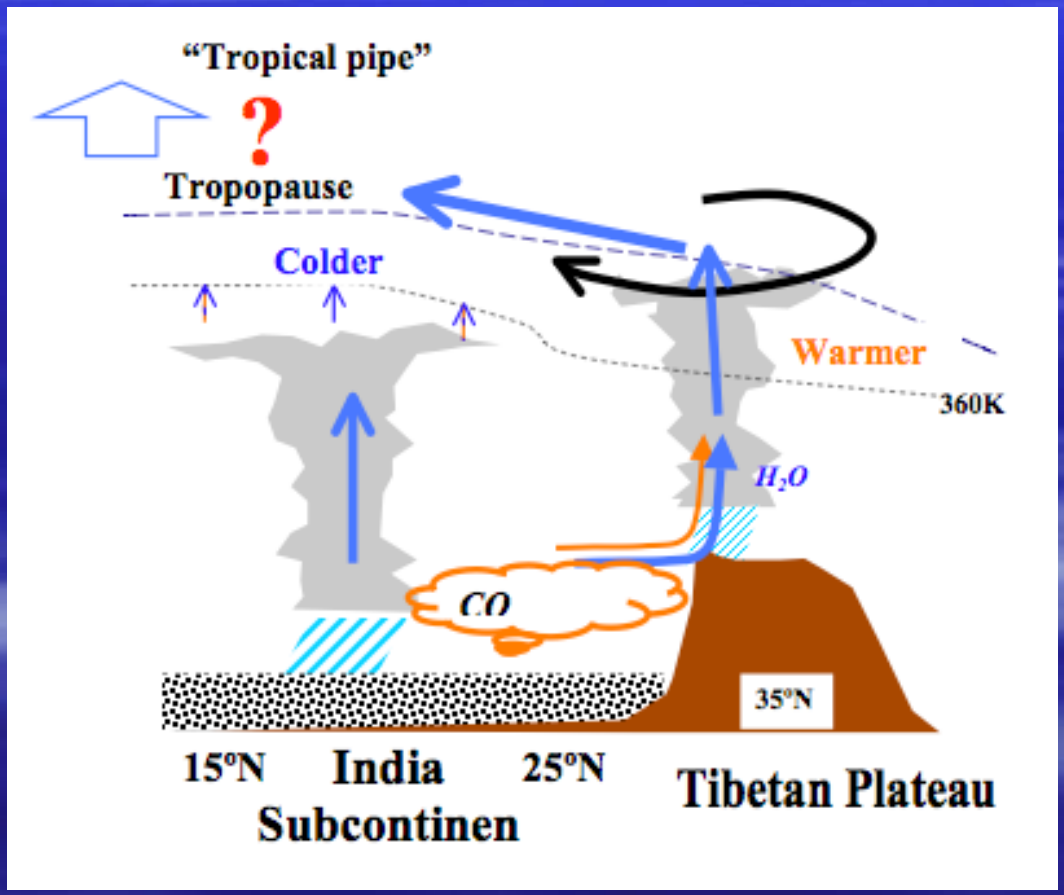
High water vapor (> 5 ppmv) at 100 hP detected by MLS during Aug. 2004 and 2005.

Air rich in water vapor appear to enters the LS primarily over the TP and its south slope.





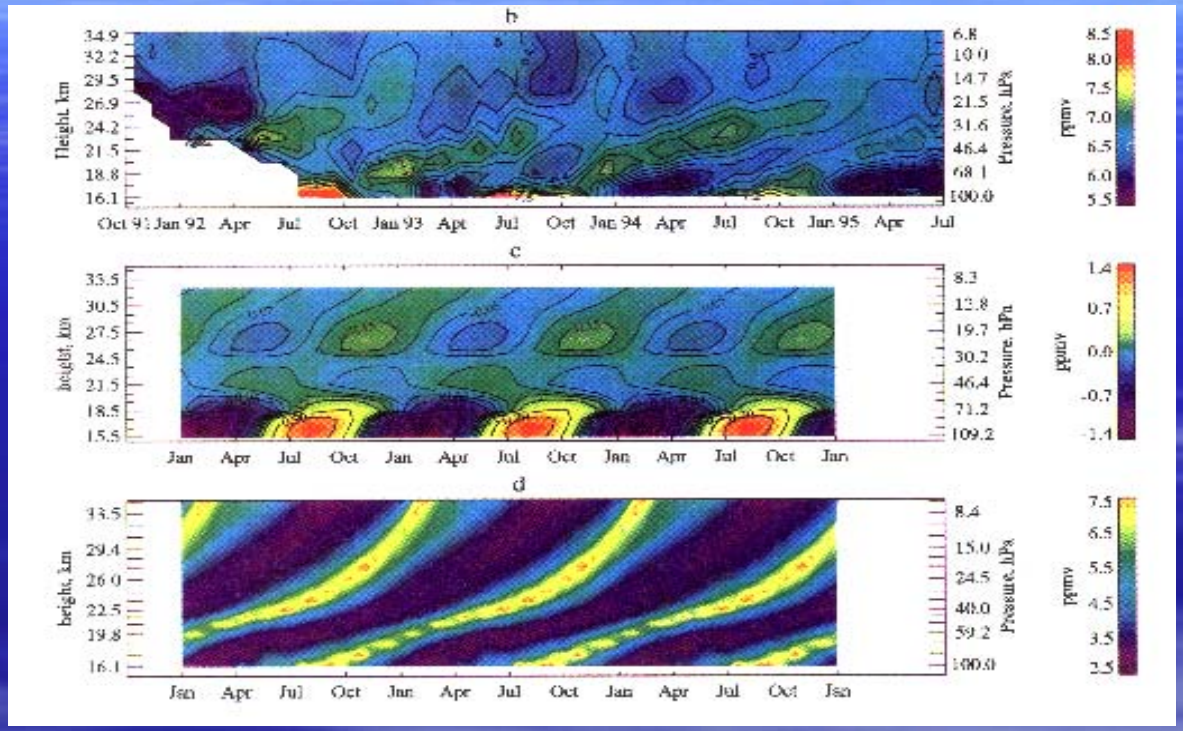
- *Why Tibet?*
- *Convection penetrates deeper,*
- *Warmer and less saturated TTL*

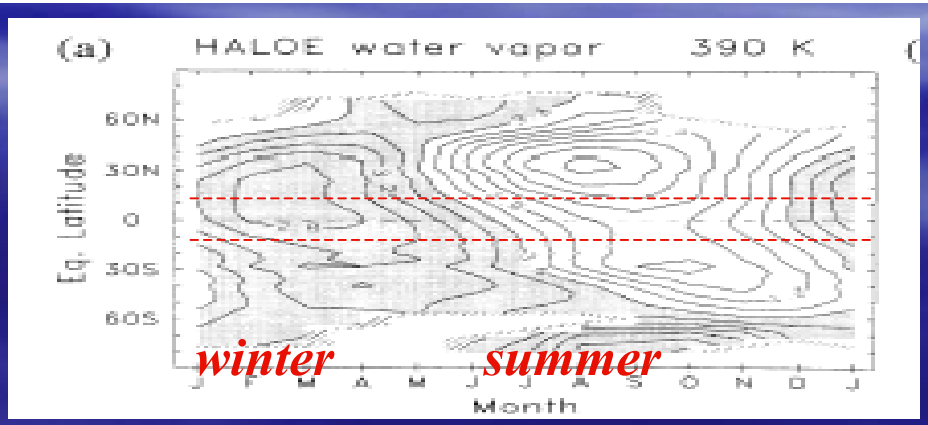


Fu et al. 2006, PNAS

Could high water vapor in the Asian monsoon/Tibetan region contribute to moist phase of the "tape recorder"?

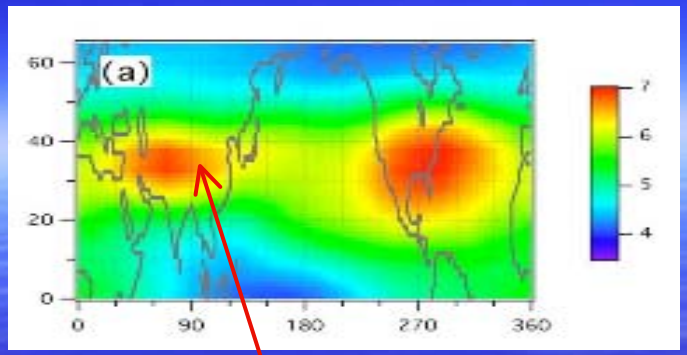
- ***Controlled by tropical tropopause temperature*** (Mote et al. 1996, 1997);
- ***Controlled by N.H., esp. Asian monsoon*** (Bannister et al. 2004; Gettelman et al. 2004)

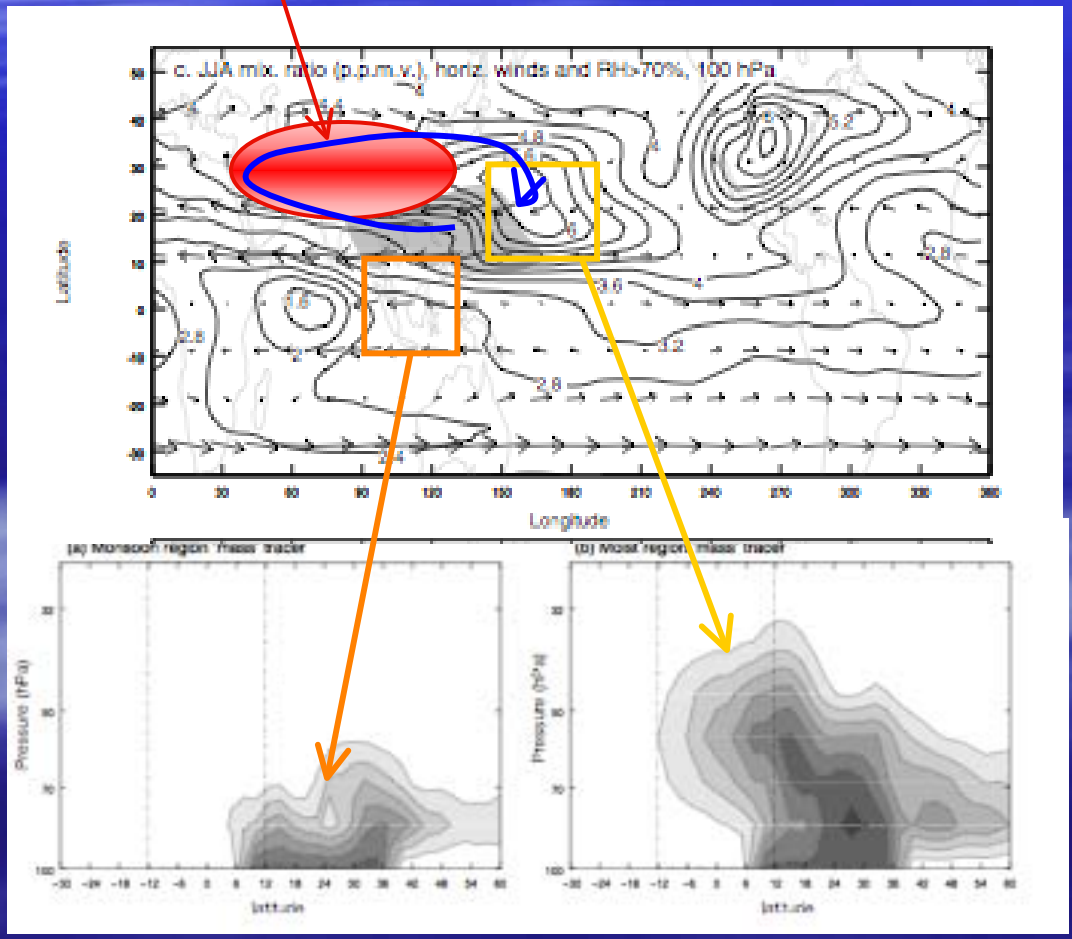




Randel et al. 2001

Dessler & Sherwood 2004





Bannister et al. (2004)

- *Water vapor in the N. Pacific, originated from the Asian monsoon region, has major contribution to moist phase of the "tape recorder", consistent with Gettelman et al. 2004.*
- *The cross troposphere air in the tropical Asian monsoon region CANNOT enter the "tropical pipe", consistent with Mote et al. 1996.*

However,

- *The moisture center is displaced to North-central Pacific in their model, instead over the Asian monsoon/Tibetan region as observed.*
- ***Is this model result believable?***

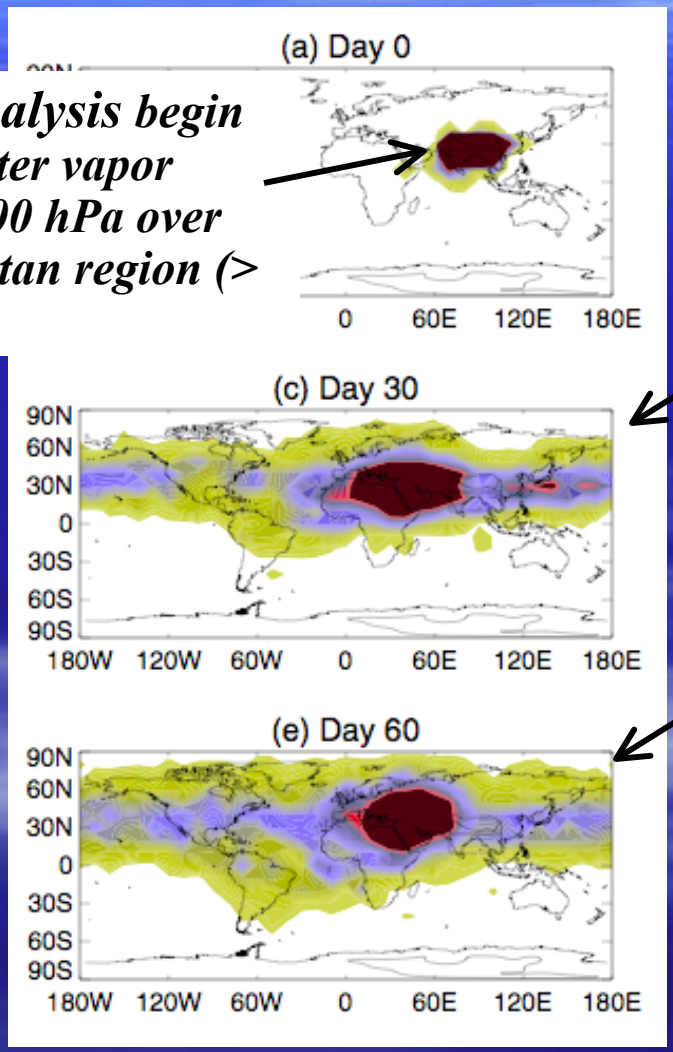
Data Sets:

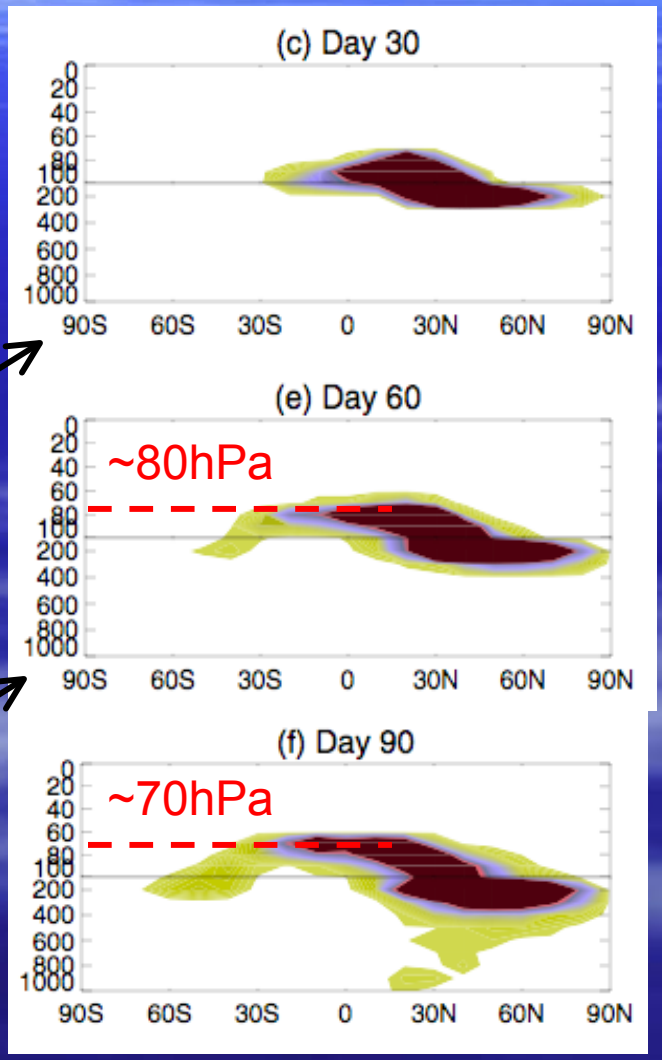
- *Aura MLS, water vapor, IWC, (V1.51, Waters et al. 2005, IEEE).*
  - *Water vapor (190 GHz): 215 hPa, 147 hPa, 100 hPa, 68 hPa, ~ 3 km vertical interval, accuracy ~10% at 100 hPa*
  - *IWC (118 GHz): 215 hPa, 178 hPa, 147 hPa, 121 hPa, 100 hPa, 83 hPa; Mainly detect cirrus/anvil, insensitive to thin cirrus (Detectable IWC: ≥0.4 mg/m^3 at 147 and 100 hPa, 4 mg/m^3 at 215 hPa,saturate when IWC>50 mg/m^3.)*

- *The Goddard Fast Trajectory model: (Schoeberl and Sparling, 1995) driven by (UKMO) reanalysis data: updated daily at 12 UTC, 2.5°×3.75° lat/lon grid.*
- *For the periods of Aug - Sept. 15 2004, July 15 - Sept. 15 2005*

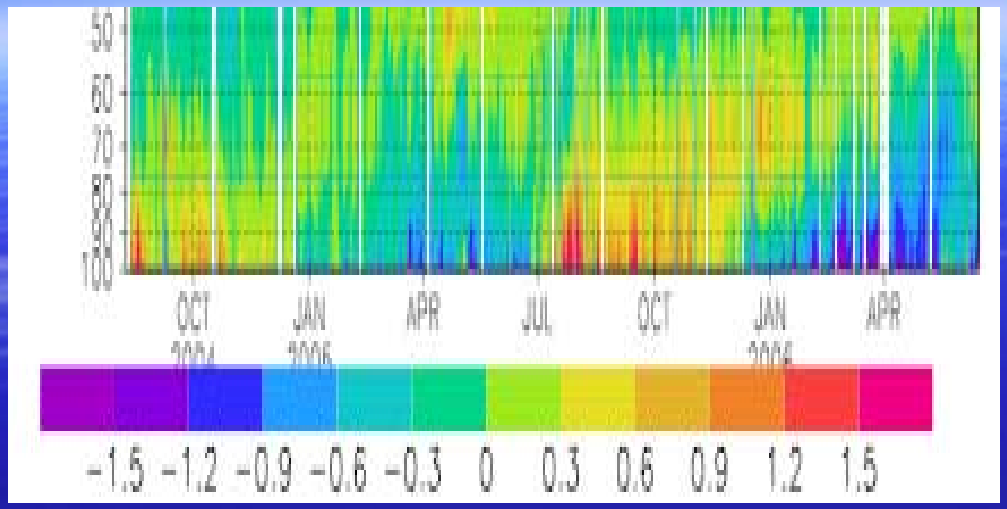
Could LS water vapor over Asian monsoon/Tibetan region enter the "tropical pipe"?

Forward trajectory analysis begin with Aura MLS high water vapor samples (> 5 ppmv) at 100 hPa over the Asian monsoon/Tibetan region (> 2000 samples).

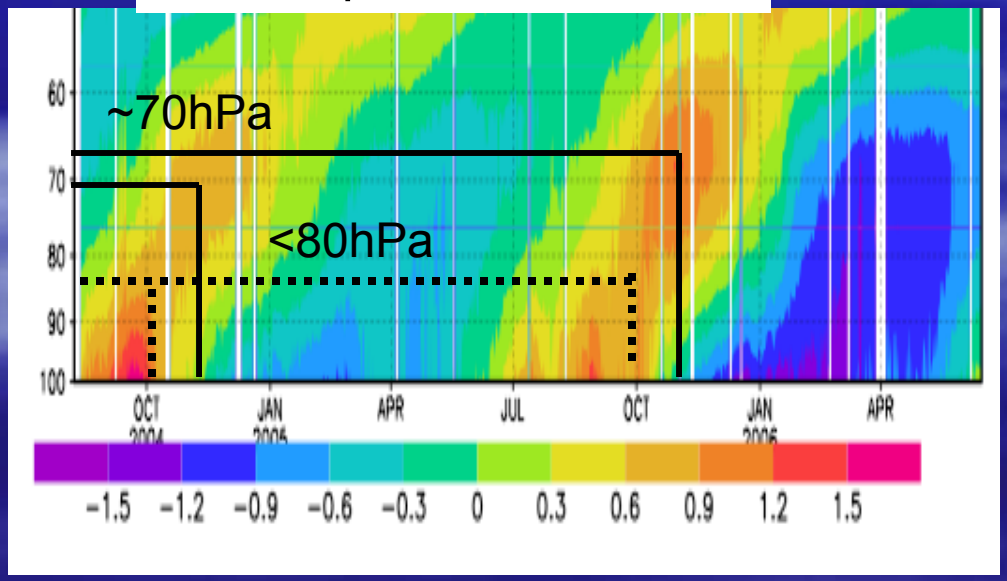




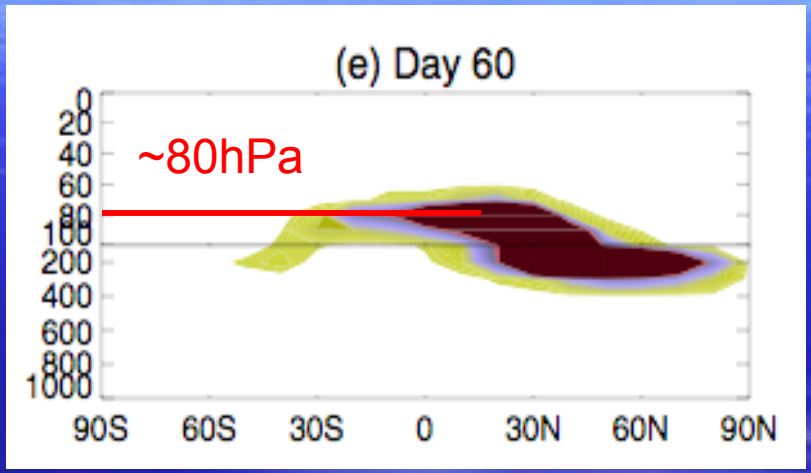
MLS “tape record”, Tibet

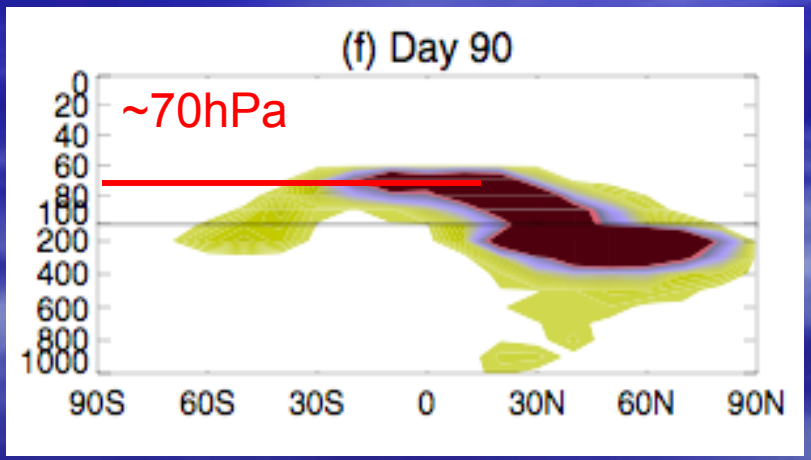


MLS “tape record” 5S-5N



Is the speed of transport reasonable?



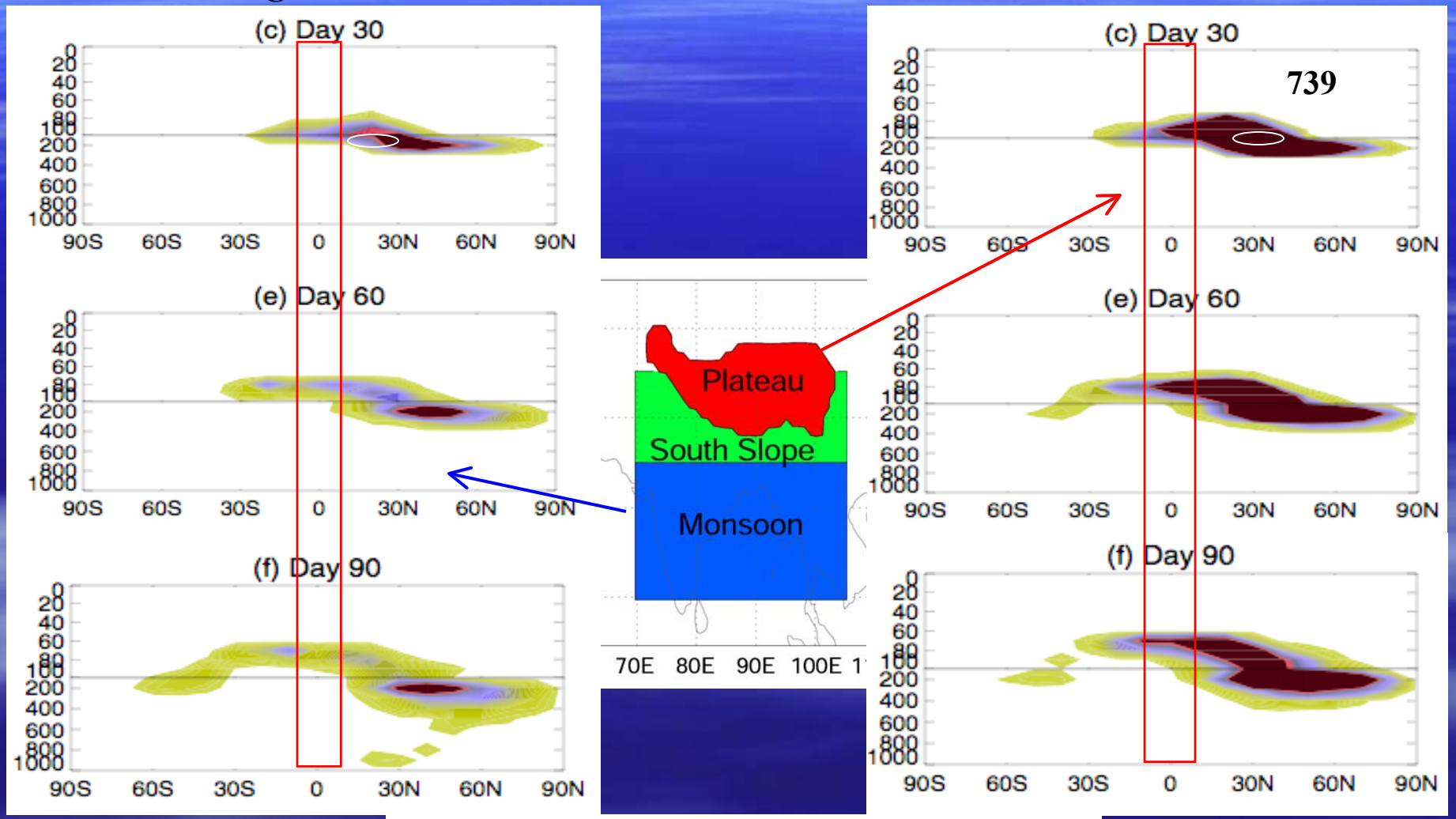


Douglass et al. 2003
Schoeberl et al. 2003

Where is the main source region?
Indian subcontinent or Tibetan Plateau?

Monsoon region: 10˚-25˚N

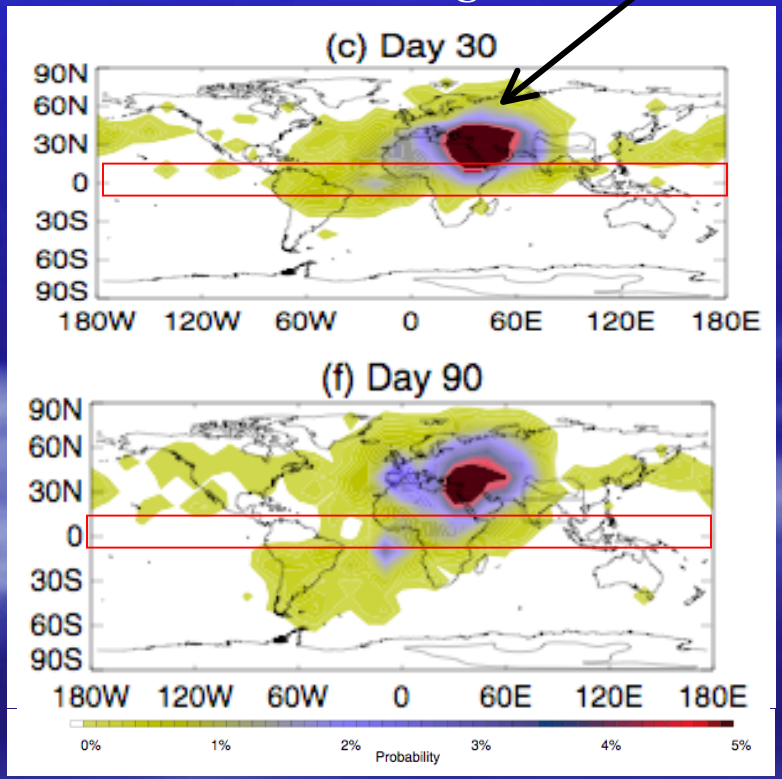
Tibetan Plateau: 27˚-35˚N



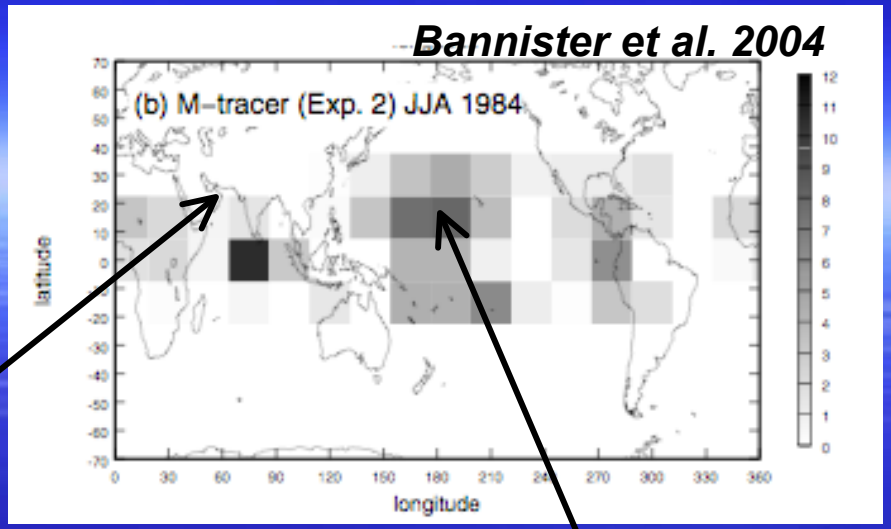
Why?

– *More water vapor from the Tibetan region can be transported to the "tape doors".*

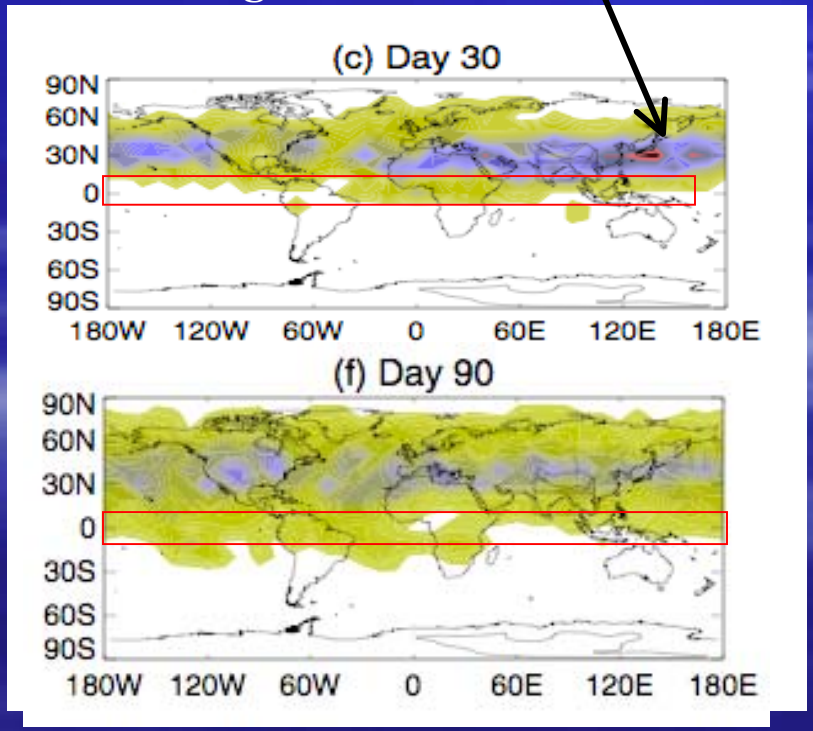
Dispersion of the LS water vapor from the Asian monsoon region



Bannister et al. 2004

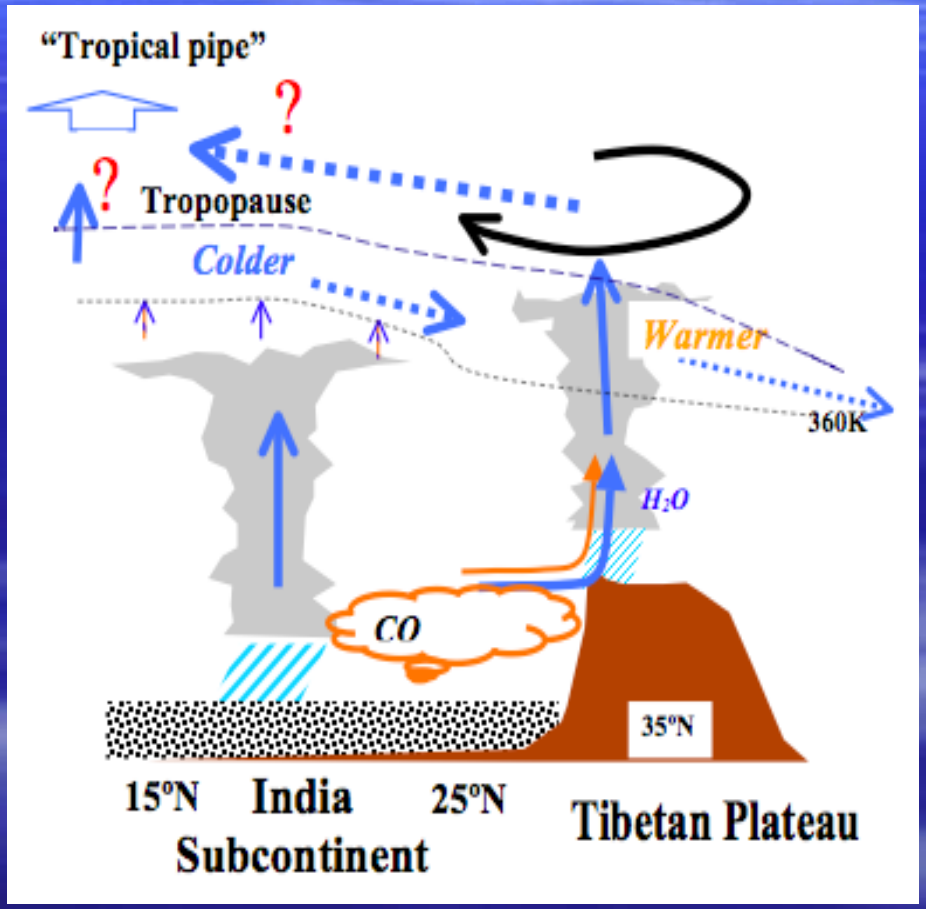


Dispersion of LS water vapor over the Tibetan region

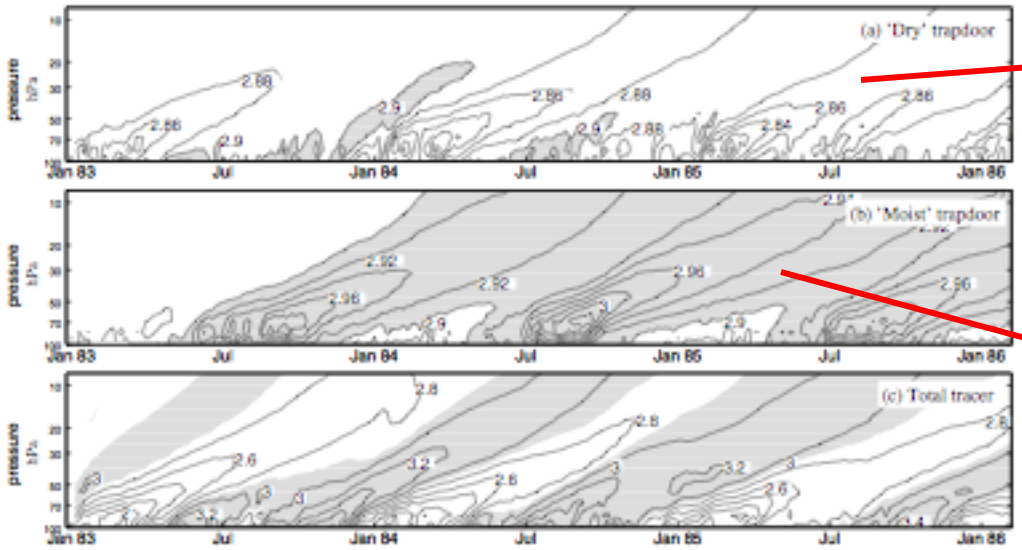


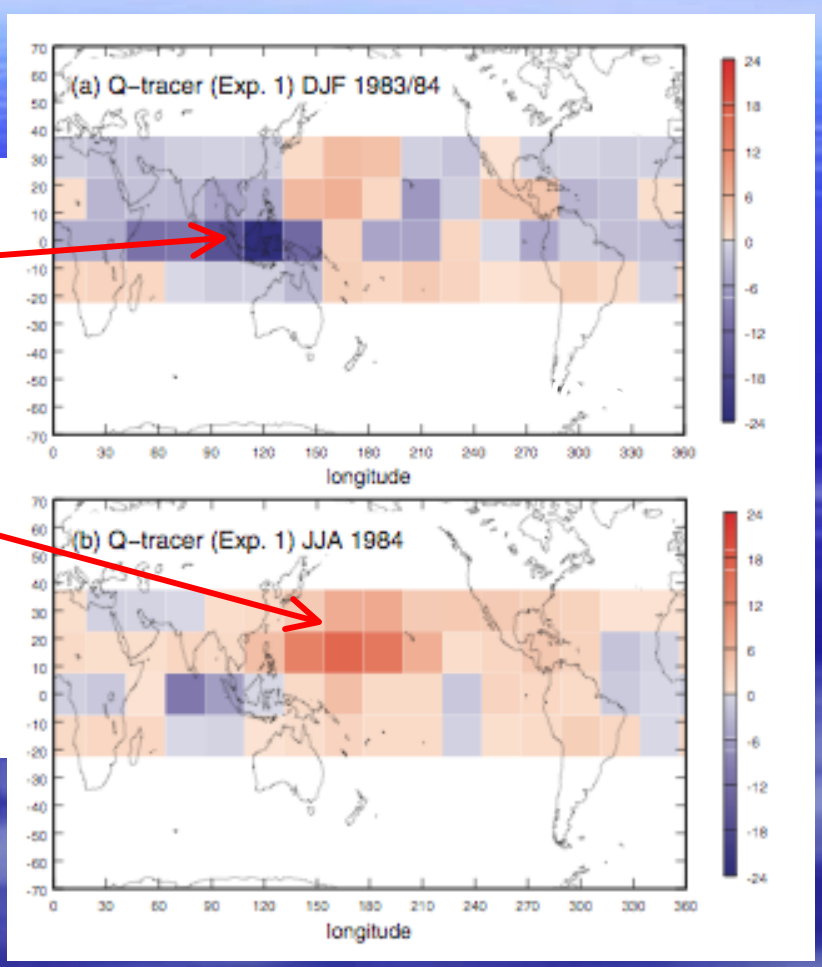
Summary and Implication:

- ✓ *Convection over Tibetan Plateau transport more water vapor to the lower stratosphere in the Asian monsoon region.*
- ✓ *More water vapor enters the "tropical pipe" from Tibetan Plateau than from the Asian monsoon region.*
- ✓ *Other tracers can be transported by the same processes.*



Could LS moisture in the Asian monsoon/Tibetan region enter the "tropical pipe"?





- *Water vapor in these "tapedoors" contributes to >25% of the water vapor in middle stratosphere.*

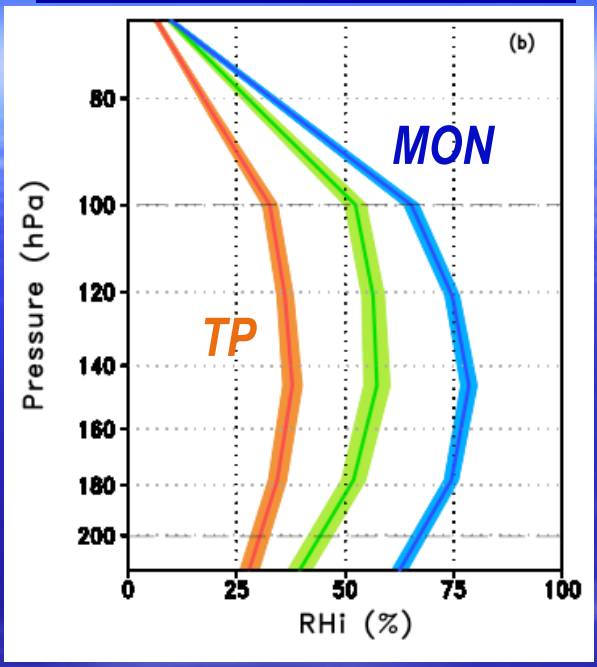
- *Barnnister et al. (2004)*

Why?

- *Tropopause temperature:*
  - *Tibetan Plateau > SLP > monsoon area*

  Allows extra 7-8 ppmv of vapor at the tropopause over the TP.
- *Ambient RH_i:*
  - *Tibetan Plateau (40%) < SLP (60%) < monsoon area (75%)*
- *Cirrus particle sizes:*
  - *Tibetan Plateau >monsoon area*

Aural MLS, Aug-Sept 04,05



Aura MLS clear-sky temperatures:

θ	TP	SLP	MON
380K	203K +7K	199K +2K	197K
360K	212K +12K	208K 8 K	200K